

REMARKS

Claims 1-4 are pending in the application. Claims 1 and 4 are herein amended. No new matter has been presented.

Rejections under 35 USC §103(a)

Claims 1-4 were rejected under 35 U.S.C. 103(a) as being obvious over Baiker et al. (U.S. Patent No. 4,916,109(Baiker)), further in view of “Crystallization of amorphous Zr-Ni alloys in the presence of H₂ GO, O₂, N₂ and argon gases”, Aoki et al., Journal of Materials Science, Vol. 21 pages 793-798, 1986(Aoki).

Claim 1 has been amended to recite “Zr_{100-a-b}Pd_aNi_b (wherein $15 \leq a \leq 40$, $2 < b \leq 10$).”

Responding to Applicants' previous response, the Examiner alleged as follows:

In the remarks, applicant argues that even if both ZrNi and ZrPd are known amorphous alloys that absorb hydrogen(i.e. as taught by Aoki), it does not mean that Ni and Pd are interchangeable because it is difficult to predict how an additional element will affect an alloy.

The examiner does not find applicant's argument convincing because **Aoki clearly teaches that ZnNi and ZnPd are functionally equivalent hydrogen absorbing material and catalyst material**, one of ordinary skill in the art would have found it obvious to have partially substituted Pd in the ZnPd metal alloy of Baiker with Ni and achieve the same expected success of obtaining a hydrogen absorbing material and/or a catalyst material.

(Office Action, page 4, lines 11-20). However, Aoki et al. simply says that it has been reported that zirconium-based Zr-Ni and Zr-Pd amorphous alloys absorb considerable quantity of hydrogen and act as catalysts for the hydrogenation of carbon monoxide. Nothing in Aoki et al. indicates that Ni and Pd are interchangeable.

The Examiner further alleged as follows:

In addition, the examiner has discovered following supporting documents demonstrating using metals such as Zr with Pd and Ni together are known in the hydrogen storage alloy art:

Grasselli et al. US 4,728,580(Grasselli) teach an amorphous hydrogen storage alloy of formula $AaMbM'c$, wherein A can be Pd, M can be Ni, and M' can be Zr(abstract).

Claim 24 of Grasselli further teaches a $Pd_{a}Ni_{b}Zr_{c}$ alloy wherein Zr, Pd and Ni are used together in a hydrogen storage alloy.

Gamo et al. US 5,490,970(Gamo) teach a hydrogen storage alloy having a formula $Zr_{a}Ni_{b}M_{c}$, wherein M can be Pd(col. 5 lines 51-62).

Therefore, applicant's argument is not convincing.

(Office Action, page 5, lines 1-10). However, Grasselli et al. and Gamo et al. do not change the situation. Grasselli et al. discloses a wide variety of hydrogen storage. Grasselli et al. describes at the cited portion as follows:

24. A structure for reversibly storing hydrogen including an active hydrogen absorption surface layer said layer having an outside surface for contacting hydrogen and an interface surface, and a bulk hydrogen storage material in contact with said active surface layer at said interface surface, the active surface layer comprising a substantially amorphous metal alloy having the formula: $Pd_{a}Ni_{b}Zr_{c}$ where
 a ranges from about 0.005 to about 0.80,
 b ranges from greater than zero to about 0.70,
 c ranges from about 0.08 to about 0.95, and
 a plus b plus c equals about 1.00, wherein the surface layer has a compositional gradient such that a substantial portion of the palladium of said alloy is disposed on the outside surface of said active surface layer, the bulk storage material comprising a material that can reversibly store hydrogen.

(Grasselli et al., claim 24). Thus, claim 24 of Grasselli et al. covers Pd-Ni-Zr alloy of 0.5-80% of Pd, 0-70% of Ni, and 8-95% of Zr. This composition range ignores practical range of composition of the hydrogen storage alloy.

The hydrogen storage alloy of the present invention, contains Pd in the range of 15 to 40 atomic %. If a content of Pd is less than 15 atomic % or greater than 40 atomic %, the hydrogen absorption/desorption capacity of the alloy will become too little to be used practically.

Also, the hydrogen storage alloy of the present invention contains 2 to 10 atomic % of the metal M. If a total content of Pd and the metal M ("a + b") is less than 15 atomic % or greater than 50 atomic %, and a content of Zr is out of the range of 85 to 50 atomic %, then an alloy prepared by a rapid solidification process cannot have an amorphous structure.

Moreover, the content of Pd deviating from the range of the present invention causes a change in microstructure. These lead to lowered hydrogen absorption/desorption amounts, resulting in loss of practicality.

Grasselli et al. discusses nothing about this complex balance of the ingredients.

Gamo et al. describes at the cited portion as follows:

As a result, the inventors have found that the best results are obtained when the alloy composition falls within a range which is expressed by a general formula of $Zr\alpha V\beta Ni\gamma M\delta$, where α , β , γ , and δ represent atomic ratios of Zr, Ni and M, satisfying the conditions of $\alpha=0.5$ to 1.5 , $\gamma=0.4$ to 2.5 and $\delta=0.01$ to 1.8 , $\gamma+\delta=1.2$ to 3.7 , while M represents one selected from the group consisting of: a single substance of Fe; and Fe and at least one selected from the group consisting of V, Mg, Ca, Y, Hf, Nb, Ta, Cr, Mo, W, Mn, Co, Pd, Cu, Ag, Au, Zn, Cd, Al, Si, In, Sn, Bi, La, Ce, Mm, Pr, Nd, Th and Sm.

(Gamo et al., column 5, lines 51-62). Thus, Gamo et al. discusses Zr-V-Ni-M system, which is different from that of the present invention.

Furthermore, the hydrogen storage alloy of the present invention excels in Pd weight-based hydrogen desorption amount over the Zr-Pd hydrogen storage alloy. This can be confirmed by comparing Inventive Examples 1 and 2 with Comparative Examples 1 and 2 in Table 1. Such effect was not expected from the cited references.

For at least these reasons, claim 1 patentably distinguishes over Baiker et al., Aoki et al., as well as Grasselli et al. and Gamo et al. Claims 2-4, depending from claim 1, also patentably distinguish over the cited references for at least the same reasons.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,
WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP

/Sadao Kinashi/

Sadao Kinashi
Attorney for Applicants
Registration No. 48,075
Telephone: (202) 822-1100
Facsimile: (202) 822-1111

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